Wir haben nun für 17 Säugetierarten (Tab. 2, Abb. 4) aus verschiedenen systematischen Einheiten die interspezifische Allometriegerade berechnet, sie lautet: log HSK = –0,0015 + 1,02 · log HV (r = 0,0997). Die Beziehung ist positiv allometrisch und stimmt fast mit der von Martin (1990) ermittelten überein. Der Wert HSK%HV nimmt von kleinen bis zu großen Gehirnen zu, und zwar von 102% bis zu 116% (Tab. 2, 5). Das heißt, besonders bei größeren Gehirnen kann die Differenz zwischen HSK und HV ein beträchtliches Ausmaß erreichen. Diese höhere Differenz könnte auch durch Zunahme der Volumina der Subarachnoidalräume und der Dicke der Dura mater bedingt sein. Quantitative Daten über die Größen dieser Strukturen liegen nicht vor.

In Tabelle 5 sind die Mittelwerte HSK%HV für die 17 untersuchten Arten aufgeführt und mit denen nach der o. a. interspezifischen Allometriegleichung ermittelten Werte „HV"%HV verglichen. Es ist eindeutig, daß die Schätzung des HV nach der Allometriegleichung HSK–HV weit bessere Werte liefert als die Gleichsetzung von HSK und HV. Wir schlagen daher vor, die von uns errechnete Allometriegerade HSK–HV von 17 Säugetierarten zu verwenden, wenn für Säuger das Hirnvolumen nach der Hirnschädelkapazität geschätzt werden soll. Wünschenswert sind weitere Datenpaare von HSK und HV, um die Zuverlässigkeit der Geraden zu verbessern.

Tabelle 5. Vergleich HSK%HV mit „HV"%HV. „HV" berechnet nach der interspezifischen Allometriegeraden HSK–HV für 17 Säugetierarten

Spezies	HSK%HV	„HV"%HV
Oryctolagus cuniculus	102,45	97,73
Mustela nivalis	104,62	103,02
Mustela erminea	103,23	99,89
Martes foina	108,61	101,92
Eira barbara	108,35	100,09
Dusicyon sechure	102,54	95,90
Dusicyon gymnocercus	104,33	96,59
Cerdocyon thous	108,76	100,28
Dusicyon culpaeus	104,80	96,39
Canis aureus	110,70	101,38
Canis latrans	108,24	98,50
Canis lupus	112,31	101,18
Lama guanacoe	108,29	96,27
Hausziege	116,09	104,82
Tamandua tetradactyla	107,95	100,78
Myrmecophaga tridactyla	116,97	106,42
Zooprzewalskipferd	116,31	101,52

Zusammenfassung

Zur Ermittlung der Größe des Hirnvolumens von Säugetieren wird häufig die Messung der Hirnschädelkapazität eingesetzt. Hirnvolumen und Hirnschädelkapazität stimmen aber nur bei kleinen Säugetieren überein. Für 17 Säugetierarten (451 Individuen) konnten wir nachweisen, daß die Hirnschädelkapazität größer ist als das Hirnvolumen. Die Größenunterschiede sind bei den einzelnen Arten nicht gleich. Der Mittelwert Hirnschädelkapazität % Hirnvolumen reicht von 102,45% bis 116,97%. Die Bewertung der Größe der Hirnschädelkapazität als Maß für das Hirnvolumen kann zu beträchtlichen Fehleinschätzungen der Hirngröße führen.

Die intraspezifische allometrische Beziehung Hirnschädelkapazität – Hirnvolumen kann isometrisch oder positiv allometrisch sein, die interspezifische ist positiv allometrisch. Sind solche Allometrien bekannt, dann kann man für Individuen von Arten mit unbekanntem Hirnvolumen, aber bekannter Hirnschädelkapazität die Hirngröße abschätzen. Entsprechendes gilt für Arten im interspezifischen Bereich.

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Short communication

Reproductive ecology of the endangered monogamous Malagasy giant jumping rat, *Hypogeomys antimena*

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Hypogeomys antimena, the Malagasy giant jumping rat, is the largest extant endemic rodent of Madagascar. Both sexes are ca. 30 cm long and weigh ca. 1.2 kg. It is considered to be one of the most endangered mammalian species of Madagascar. The distribution of this rodent has greatly diminished during the past two millennia. The last remaining population is restricted to patches of dry deciduous forest with a total extension of 20 km × 40 km situated north of the town Morondava, along the western coast of Madagascar. The whole area is subject to slash and burn agriculture and commercial logging (GENINI 1996; GOODMAN and RAKOTONDRAVONY 1996). Until recently, the information on *H. antimena* was limited to anecdotal information (PETTER 1972; STARCK 1974) and preliminary data from a nine-week field study by COOK et al. (1991). *H. antimena* was reported to be strictly nocturnal, to live in long deep burrows and to move by jumping and running. It was suggested that the rodent lives in social units, probably consisting of a pair plus their offspring. The most surprising information for a rodent species was that it produces only a single offspring per year. Most rodent species are characterised by large litter sizes, short birth intervals and sexual maturation at an early age (HASLER 1975).

In order to increase our very limited knowledge of the biology, ecology, and behaviour of *H. antimena* and for conservation purposes long-term field studies were initiated in 1992. It turned out that *H. antimena* has some very unusual life characteristics for a rodent species such as an obligate monogamous social and mating system. Pairbonds apparently last until one mate dies. Mates defend an exclusive territory throughout the year (for more details see SOMMER 1996; 1997; 1998; 2000; SOMMER and TICHY 1999). One critical component to understand the population dynamics of an endangered species is its reproductive ecology (for reviews on the behaviour-conservation interface see SUTHERLAND 1998; CARO 1999). The aim of this study therefore was to investigate length of the reproductive period, reproductive rate, and offspring growth of the endangered *H. antimena* in its natural habitat.

Field studies were carried out in the 12 500 ha forestry concession of the Centre de Formation Professionnelle Forestière de Morondava (C.F.P.F.) in the Kirindy Forest (20°03′S 44°39′E) at the research station

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of the German Primate Center (DPZ, Göttingen, Germany). A detailed description of the area is given in Ganzhorn and Sorg (1996). Field work took place between October 1992 and January 1993, February and April 1994, April and June 1995, November and December 1995 and April and June 1996. In a 100 ha study area, all existing burrow systems were known and were regularly monitored and classified as active or inactive. Capture/recapture studies were carried at least once during each field period. Tomahawk live traps (51 × 19 × 19 cm, Tomahawk, Wisconsin) were set in front of the burrow holes before the nocturnal activity period of the rats started and checked at least once every hour after sunset until the animals entered the traps. Captured animals were anaesthetised for 10–15 min the next morning with an intramuscular injection of 0.1 to 0.25 ml ketamine hydrochloride (100 mg/ml), sexed, weighed, and measured. 157 animals from 30 active burrows have been marked individually with a passive integrated transponder (Trovan, Römerberg, Germany) since the beginning of the field studies in October 1992. The rats were released during their normal activity period in the evening in front of their burrows. The statistical tests were performed with SPSS (1997).

The study indicated that the reproduction of *H. antimena* is seasonal and takes place during the rainy season (Dec–March). The smallest, early born offspring was observed at the beginning of December (8th Dec) with a body mass of about 200 g and the smallest, late born offspring was observed at end of March (24th March) with a body mass of around 250 g.

In contrast to the anecdotal information on the reproductive rate, the capture/recapture studies indicated that not always a male and female couple was accompanied by a single offspring. One single offspring was present in 60 cases out of 78 investigated family units but in 11 cases two offspring of the present reproductive period lived together in a burrow system with their assumed parents. The sex ratio of offspring was balanced.

To answer the question whether this can be explained by the birth of twins or by two consecutive litters per reproductive period, the body mass of offspring which were born during one reproductive period in the same burrow were compared (Table 1). Only data were included in this analysis where all offspring of a pair could be weighed within two days. The mean difference in body mass of offspring trapped in the same burrow was 368 ± 89 g (n = 6). In one case (Dec 1992, Tab. 1) two offspring of about the same body mass (370 g, 395 g) were trapped at the same time which were assumed to be born in the same litter. The data suggest that *H. antimena* can have two single offspring born consecutively during one reproductive period but also twins might occur in natural populations. The reproductive rate per couple was calculated from trapping results after the reproductive period and was 1.5 offspring in 1994, 1.5 in 1995 and 1.1 in 1996. The average number of marked offspring per pair and year was 1.4. This might be an underestimation as

Table 1. Body mass (g) of offspring which were born during one reproductive period in the same burrow

Trapping date	1. Offspring	2. Offspring	Difference	Conclusion
10. 12. 92	395	370	25	twins
24. 03. 94	780	330	450	consecutive litters
25. 03. 94	980	730	250	consecutive litters
27. 03. 94	595	250	345	consecutive litters
27.–28. 03. 94	1175	700	475	consecutive litters
01.–02. 06. 95	1040	850	290	consecutive litters
06. 05. 95	795	400	395	consecutive litters

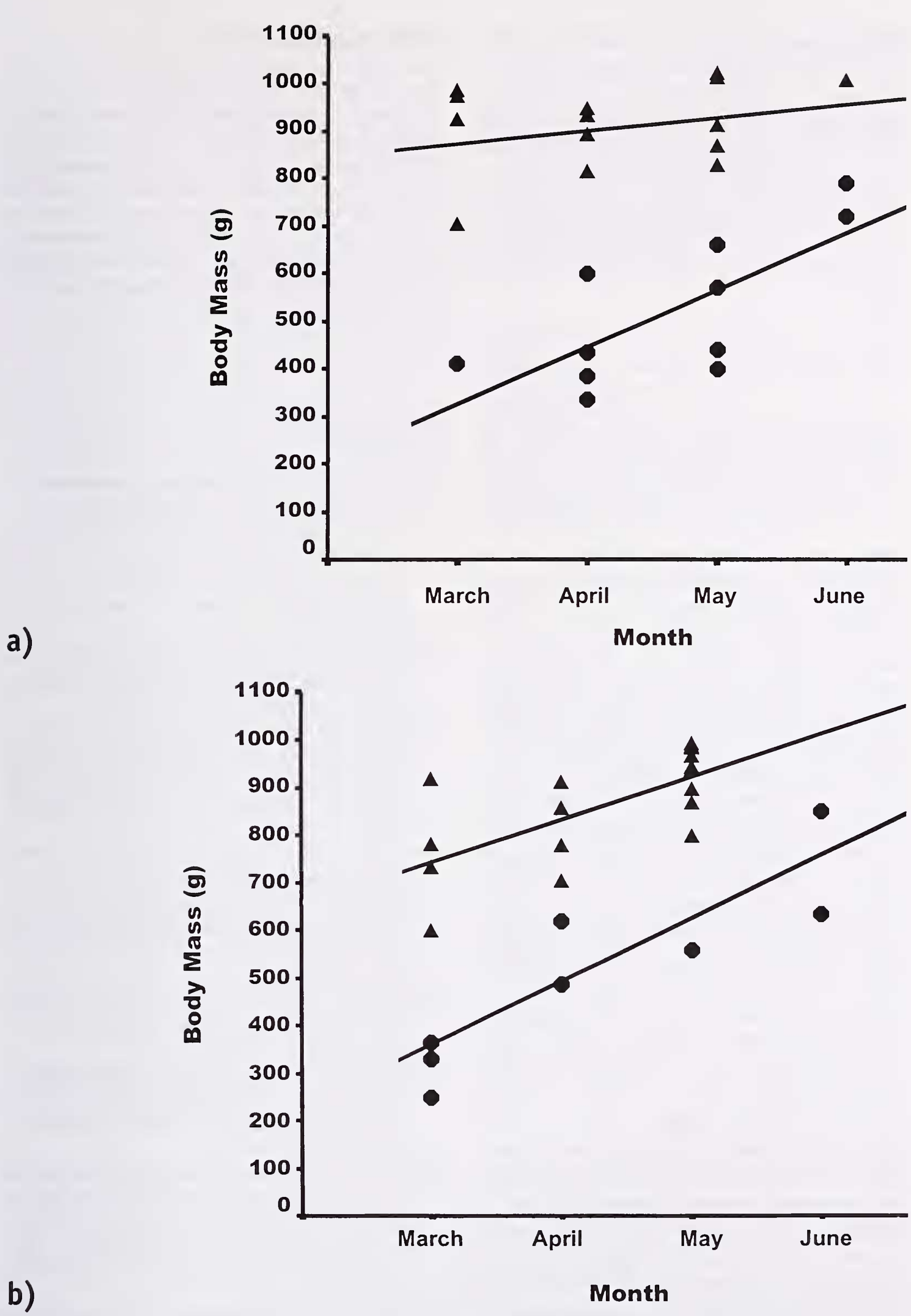

Fig. 1. Body mass of all offspring trapped between March and June. Early born offspring are symbolised by triangles, late born offspring by circles. a: male offspring, b: female offspring. Details on the linear regression lines are given in the text.